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Wan et al.

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(54) **ARTICLE OF FOOTWEAR FORMED FROM TWO PREFORMS AND METHOD AND MOLD FOR MANUFACTURING SAME**

(58) **Field of Classification Search**

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(71) Applicant: **NIKE, Inc.**, Beaverton, OR (US)

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This patent is subject to a terminal disclaimer.

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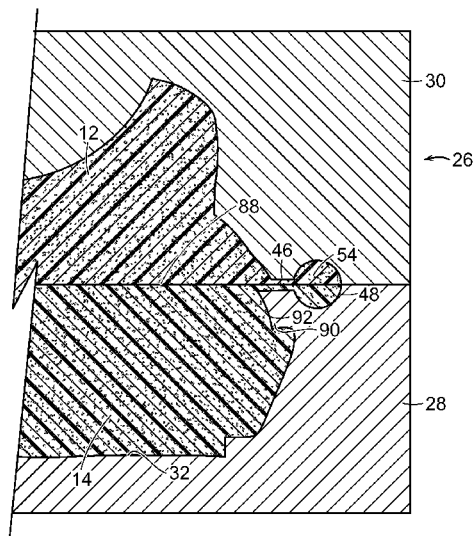
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B29C 33/00 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC **B29D 35/142** (2013.01); **A43B 13/127** (2013.01); **A43B 13/14** (2013.01);
(Continued)

(57) **ABSTRACT**

A method of manufacturing a midsole includes placing first and second preforms into a midsole recess of a mold, with first and second portions of the mold defining a first overflow chamber connected to the first recess; closing the mold by positioning the first and second portions in contact with one another; heating the mold for a predetermined period of time at a predetermined temperature such that the first and second preforms melt and bond together to form a midsole, with a portion of each of the first and second preforms flowing into the first overflow chamber to form a first overflow portion; removing the midsole from the mold; allowing the midsole to expand; and cutting away the first overflow portion.

9 Claims, 7 Drawing Sheets



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 USPC 264/161, 245; 156/83, 228, 267
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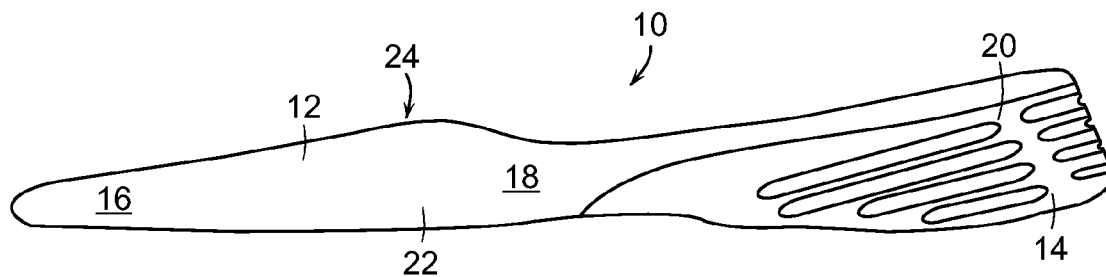


FIG. 1

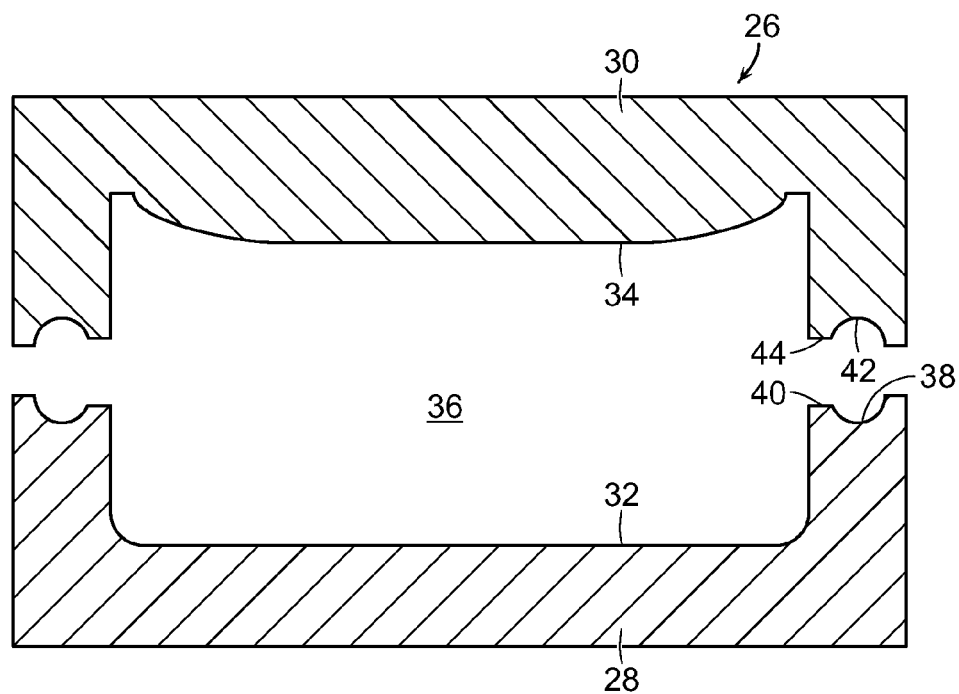


FIG. 2

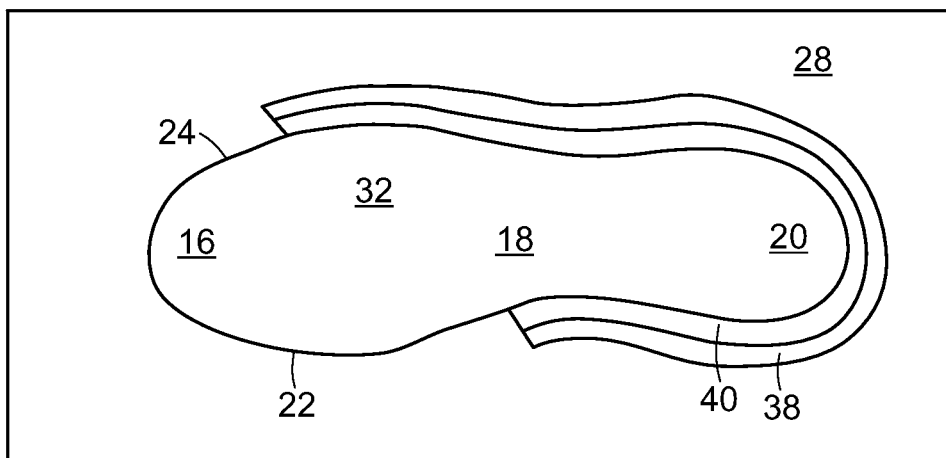


FIG. 3

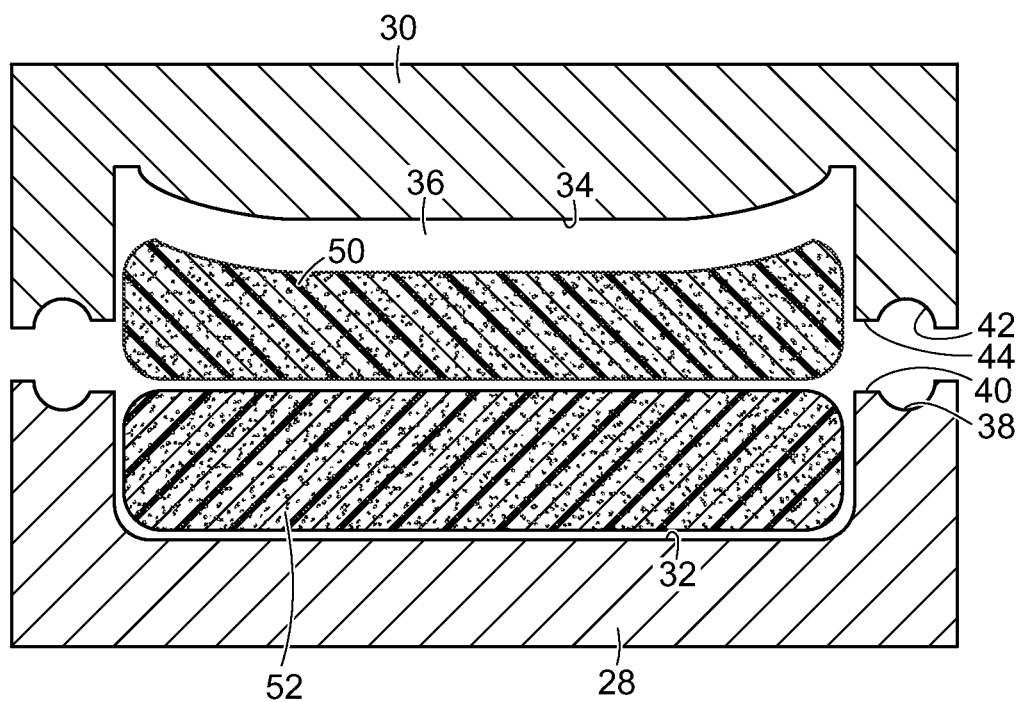


FIG. 4

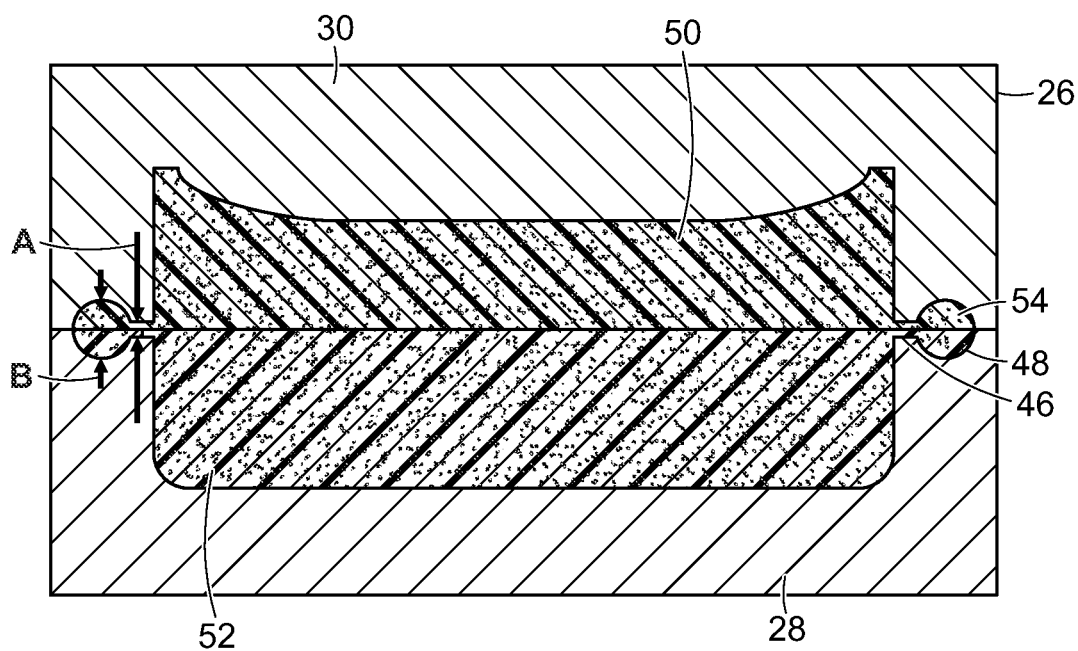


FIG. 5

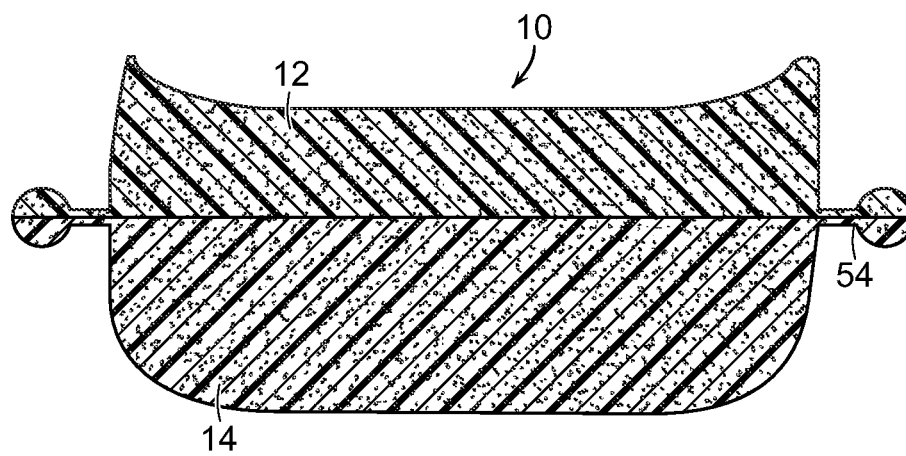


FIG. 6

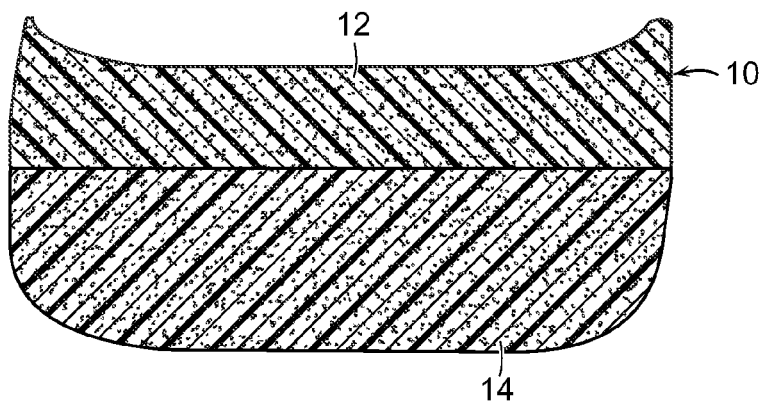


FIG. 7

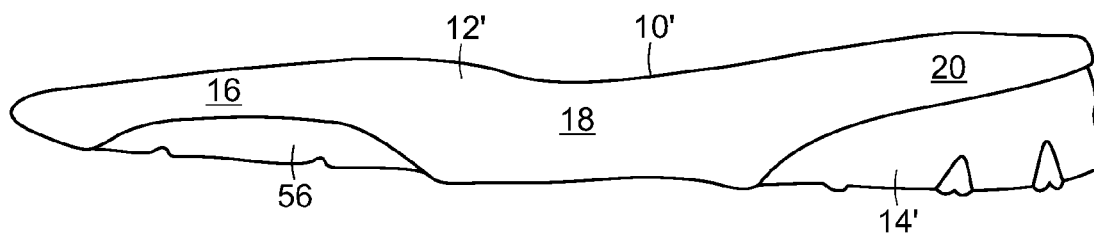


FIG. 8

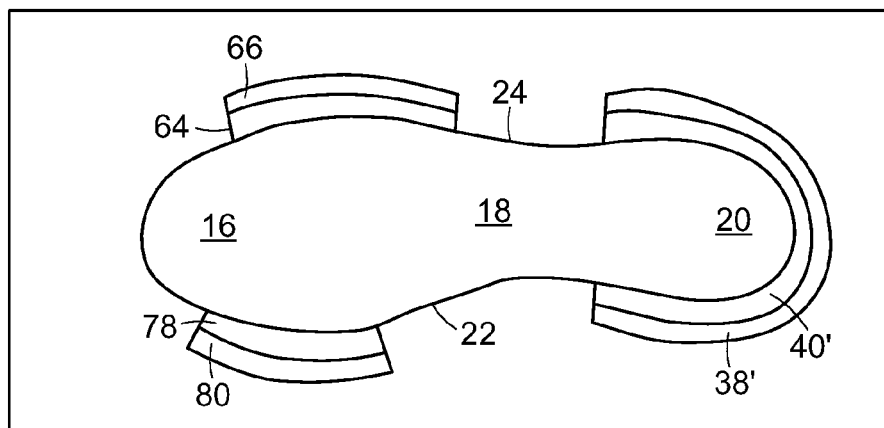


FIG. 9

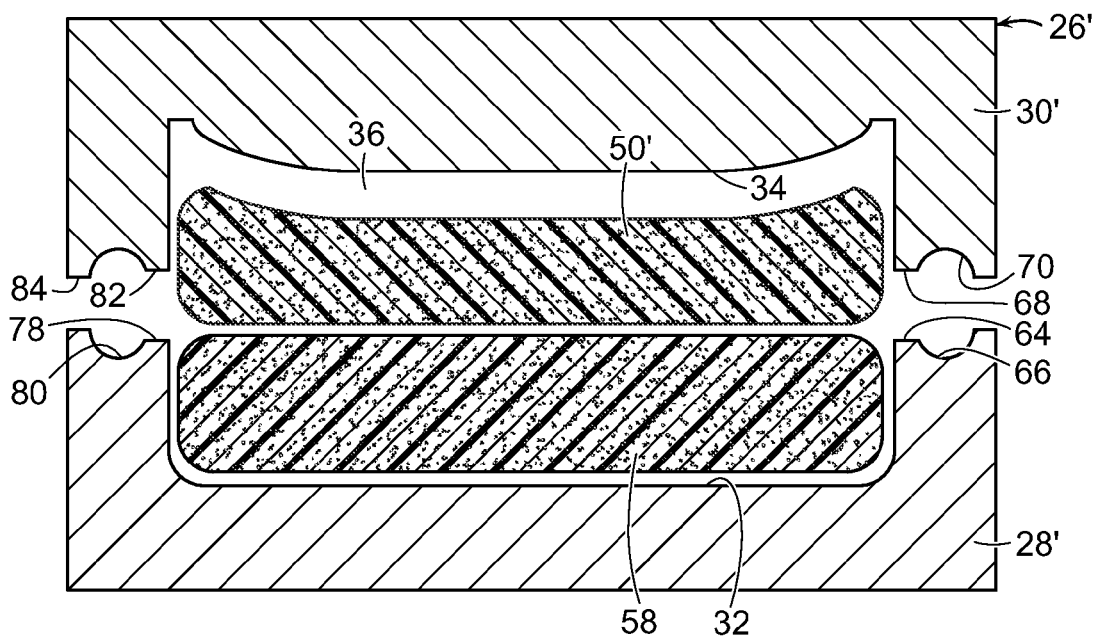


FIG. 10

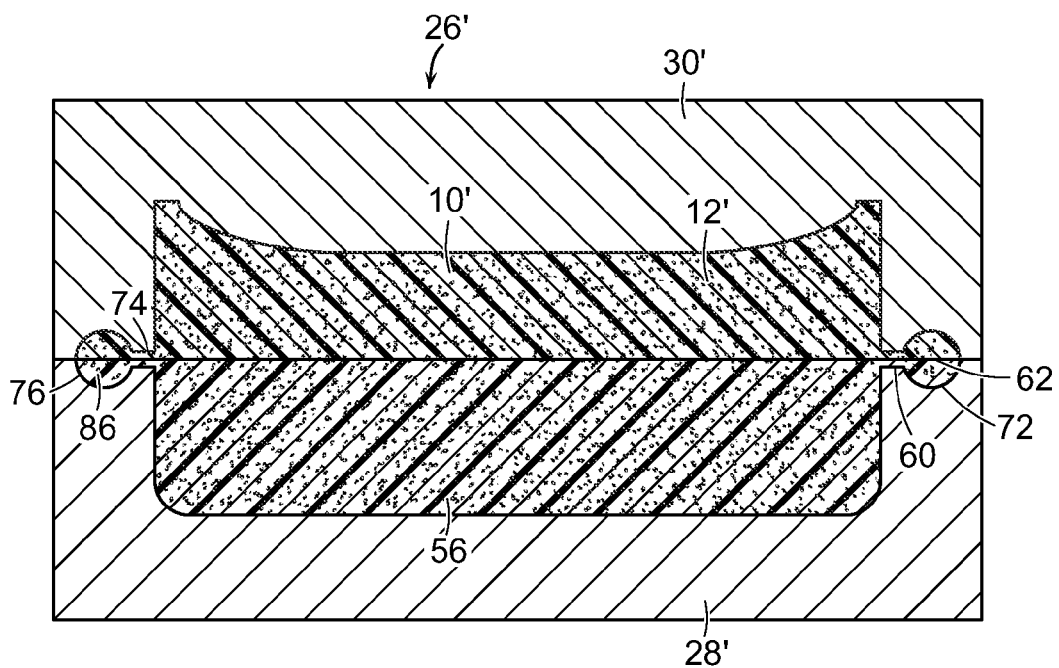


FIG. 11

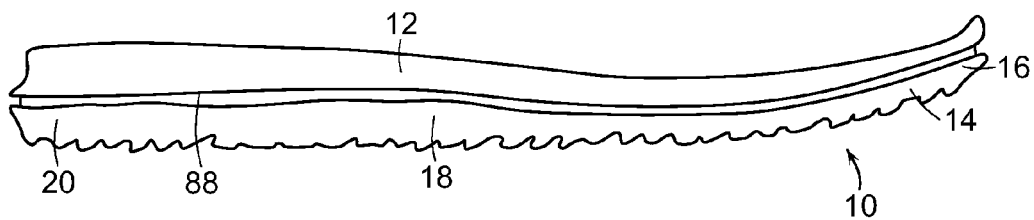


FIG. 12

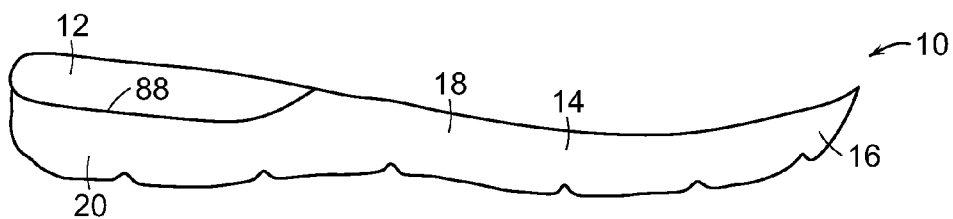


FIG. 13

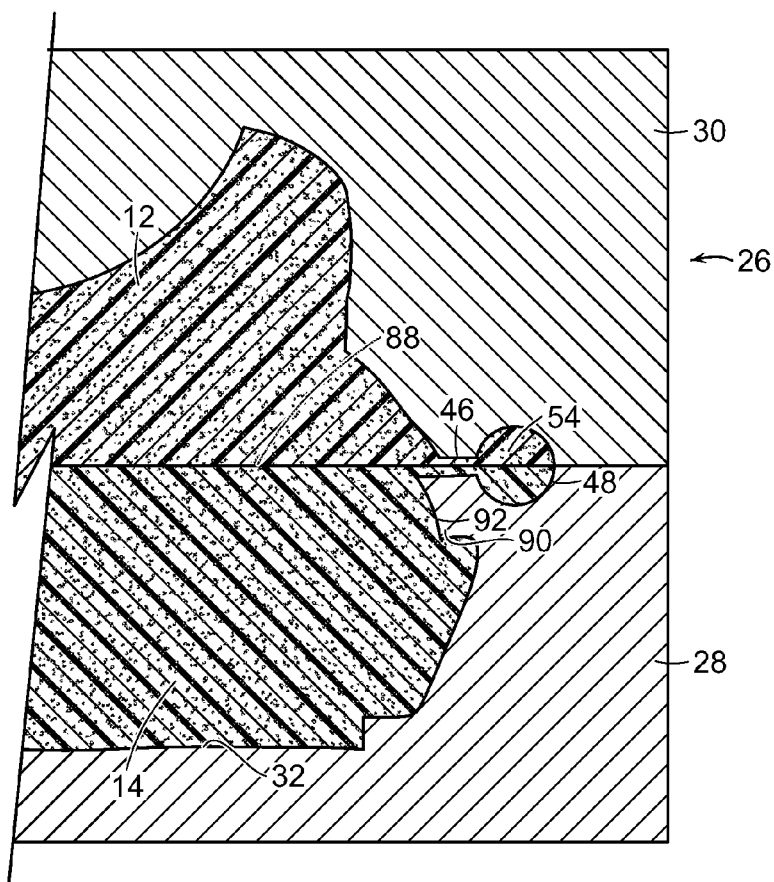


FIG. 14

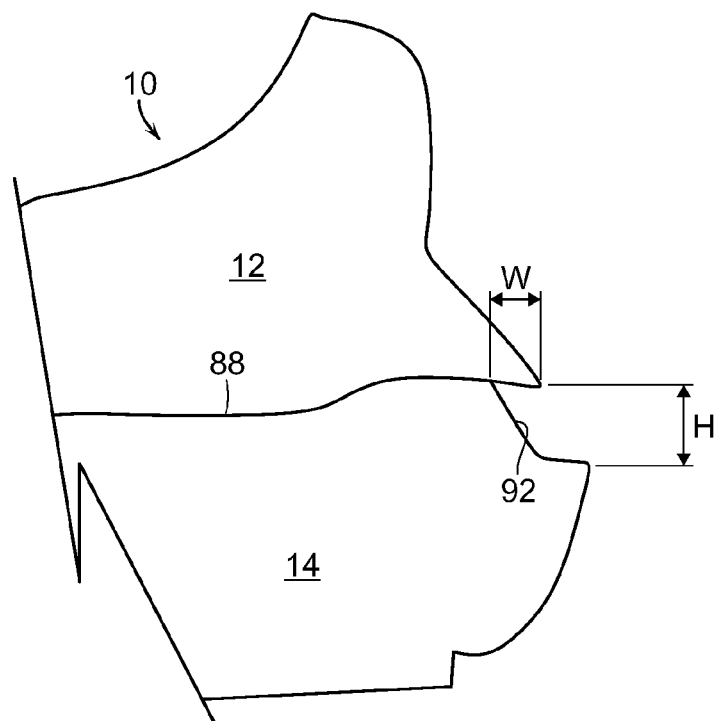


FIG. 15

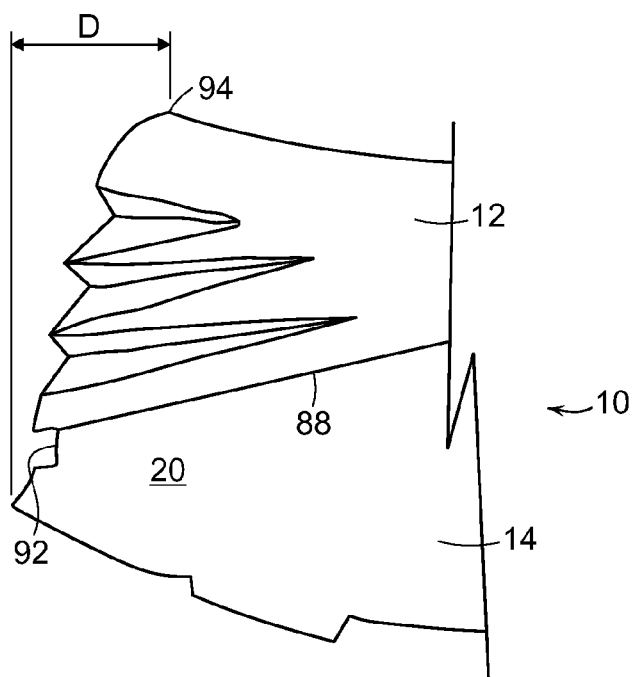


FIG. 16

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ARTICLE OF FOOTWEAR FORMED FROM TWO PREFORMS AND METHOD AND MOLD FOR MANUFACTURING SAME

RELATED INVENTIONS

This application is a continuation-in-part application of application Ser. No. 13/206,899, filed on Aug. 10, 2011, which is incorporated herein by reference in its entirety.

FIELD

Aspects of this invention relate generally to a midsole for an article of footwear, and, in particular, to midsole formed from two preforms and a method and mold for manufacturing such a midsole.

BACKGROUND

Conventional articles of athletic footwear generally include two primary elements, an upper and a sole structure. The upper is secured to the sole structure and forms a void on the interior of the footwear for comfortably and securely receiving a foot. The sole structure is secured to a lower portion of the upper and is positioned between the foot and the ground. The sole structure generally incorporates multiple layers that are conventionally referred to as an insole, a midsole, and an outsole. The insole, or sockliner, is a thin, compressible member located within the void and proximate a lower surface of the foot to enhance footwear comfort. The midsole, which is conventionally secured to the upper along the length of the upper, forms a middle layer of the sole structure and is primarily responsible for attenuating ground (or other contact surface) reaction forces to lessen stresses upon the foot and leg. The outsole forms a ground-engaging portion (or other contact surface-engaging portion) of the sole structure, and is formed from a durable and wear-resistant material that includes texturing to improve traction.

The conventional midsole is primarily formed from a resilient, polymer foam material that extends throughout the length of the footwear, often by way of a molding process. The properties of the polymer foam material in the midsole are primarily dependent upon factors that include the dimensional configuration of the midsole and the specific characteristics of the material selected for the polymer foam, including the hardness or density of the polymer foam material. By varying these factors throughout the midsole, the relative stiffness and degree of ground reaction force attenuation may be altered to meet the specific demands of the activity for which the footwear is intended to be used. In addition to polymer foam materials, conventional midsoles may include, for example, one or more fluid-filled bladders and moderators.

In many articles of footwear, the midsoles are formed of two or more materials of different colors. In the molding of such midsoles, the two different materials may bleed together during the manufacturing process, which reduces the aesthetic appeal of the footwear.

It would be desirable to provide a midsole formed from two preforms and a method and mold for manufacturing such a midsole that reduces or overcomes some or all of the difficulties inherent in prior known devices. Particular advantages will be apparent to those skilled in the art, that is, those who are knowledgeable or experienced in this field of technology, in view of the following disclosure of the invention and detailed description of certain embodiments.

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SUMMARY

The principles of the invention may be used to provide a midsole formed from two preforms and a method and mold for manufacturing such a midsole. In accordance with a first aspect, a method of manufacturing a support assembly for an article of footwear includes the steps of placing first and second preforms into a first recess in a first portion of a mold, with a second portion of the mold having a second recess that cooperates with the first recess to define a midsole recess, the first portion and the second portion cooperating to define a first overflow chamber connected to the midsole recess. The mold is closed by positioning the first and second portions in contact with one another. The mold is heated for a predetermined period of time at a predetermined temperature such that the first and second preforms melt and bond together to form a midsole within the first recess, with a portion of each of the first and second preforms flowing into the first overflow chamber to form a first overflow portion. The midsole is removed from the mold and allowed to expand. The first overflow portion of the midsole is then cut away.

In accordance with another aspect, a mold for forming a midsole includes a first portion having a first recess, a first lower chamber, and a first lower overflow recess, with the first lower chamber connecting the first lower overflow recess to the first recess. A second portion has a second recess, a first upper chamber, and a first upper overflow recess, with the first upper chamber connecting the second recess to the first upper overflow recess. The first recess and second recess cooperate to define a midsole recess, the first lower overflow recess and the first upper overflow recess combine to define a first overflow chamber, and the first lower chamber and the first upper chamber combine to define a first chamber that connects the first overflow chamber to the midsole recess, when the first portion and second portion are positioned in contact with one another such that the mold is in a closed condition.

In accordance with a further aspect, an article of footwear is formed by the steps of placing first and second preforms into a first recess in a first portion of a mold, with a second portion of the mold having a second recess that cooperates with the first recess to define a midsole recess, the first portion and the second portion cooperating to define a first overflow chamber and a first channel connecting the first overflow chamber to the midsole recess. The mold is closed by positioning the first and second portions in contact with one another. The mold is heated for a predetermined period of time at a predetermined temperature such that the first and second preforms melt and bond together to form a midsole within the first recess, with a portion of each of the first and second preforms flowing through the first channel into the first overflow chamber to form a first overflow portion. The midsole is removed from the mold and allowed to expand. The first overflow portion of the midsole is then cut away.

By providing a midsole formed from two preforms and a method and mold for manufacturing such a midsole, footwear with improved aesthetic appeal can be produced. These and additional features and advantages disclosed here will be further understood from the following detailed disclosure of certain embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevation view of a midsole of an article of footwear formed from two different preforms.

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FIG. 2 is a section view of first and second portions of a mold used to make the midsole of FIG. 1, shown in an open condition.

FIG. 3 is a plan view of the first portion of the mold of FIG. 2.

FIG. 4 is a section view of the first and second portions of the mold of FIG. 2, shown with a first preform and a second preform positioned in the mold prior to the mold being closed.

FIG. 5 is a section view of the mold of FIG. 2 shown in a closed condition with the midsole formed from the preforms after the heating step.

FIG. 6 is a section view of the midsole of FIG. 1 after being removed from the mold and having a first overflow portion.

FIG. 7 is a section view of midsole of FIG. 1 after being removed from the mold and having the first overflow portion cut away.

FIG. 8 is an elevation view of an alternative embodiment of a midsole formed of three different preforms.

FIG. 9 is a plan view of a first portion of the mold use to make the midsole of FIG. 8.

FIG. 10 is a section view of the mold used to make the midsole of FIG. 8, shown with a first preform and a third preform positioned in the mold prior to the mold being closed.

FIG. 11 is a section view of the mold of FIG. 10 shown in a closed condition with the midsole formed from the preforms and second and third overflow portions, after the heating step.

FIG. 12 is an elevation view of an alternative embodiment of a midsole of an article of footwear formed from two different preforms.

FIG. 13 is an elevation view of another alternative embodiment of a midsole of an article of footwear formed from two different preforms.

FIG. 14 is a section view of a mold, shown partially broken away and in use making the midsole of FIG. 12.

FIG. 15 is an elevation view of a portion of the midsole of FIG. 12.

FIG. 16 is an elevation view of a portion of yet another alternative embodiment of a midsole of an article of footwear formed from two different preforms.

The figures referred to above are not drawn necessarily to scale, should be understood to provide a representation of particular embodiments of the invention, and are merely conceptual in nature and illustrative of the principles involved. Some features of the mold used to form a midsole formed of different preforms and related methods of manufacture depicted in the drawings have been enlarged or distorted relative to others to facilitate explanation and understanding. The same reference numbers are used in the drawings for similar or identical components and features shown in various alternative embodiments. Molds used for forming midsoles as disclosed herein would have configurations and components determined, in part, by the intended application and environment in which they are used.

DETAILED DESCRIPTION OF CERTAIN PREFERRED EMBODIMENTS

A midsole 10 for an article of footwear is depicted in FIG. 1 as including a first portion 12 formed of a first material, and a second portion 14 formed of a second material. Midsole 10 serves to provide shock-attenuation and energy-absorption for an article of footwear. Midsole 10 can be used for any of various articles of casual footwear having con-

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figurations suitable, for example, for walking or lounging. Midsole 10 may also be included as part of a wide range of athletic footwear styles, including shoes that are suitable for soccer, running, basketball, baseball, cross-training, football, rugby, tennis, and volleyball, for example. An individual skilled in the relevant art will appreciate, therefore, that the concepts disclosed herein with regard to midsole 10 may be applied to a wide variety of footwear styles, in addition to the specific styles discussed herein and depicted in the accompanying figures.

For purposes of reference in the following description, midsole 10 may be divided into three general regions: a forefoot region 16, a midfoot region 18, and a heel region 20. Regions 16-20 are not intended to demarcate precise areas of midsole 10. Rather, regions 16-20 are intended to represent general areas of midsole 10 that provide a frame of reference during the following discussion. Although regions 16-20 apply generally to midsole 10, references to regions 16-20 also may apply specifically to first portion 12, second portion 14, or individual components or portions of midsole 10.

For purposes of reference, midsole 10 includes a medial side 22 and an opposite lateral side 24.

Lateral side 24 is positioned to extend along a lateral side of the foot (i.e., the outside) and generally passes through each of regions 16-20. Similarly, medial side 22 is positioned to extend along an opposite medial side of the foot (i.e., the inside) and generally passes through each of regions 16-20.

The materials used to form first portion 12 and second portion 14 of midsole 10 may include any of the conventional polymer foams that are utilized in footwear midsoles, including ethylvinylacetate ("EVA") and polyurethane ("PU") foam. Other suitable materials for first portion 12 and second portion 14 will become readily apparent to those skilled in the art, given the benefit of this disclosure.

In certain embodiments, first portion 12 is formed of a material having a first color, while second portion 14 is formed of a material formed of a second color that is different than the first color. First and second portions 12, 14 may also have different physical properties.

In the illustrated embodiment, second portion 14 is positioned beneath first portion 12 and extends from the rear edge of heel region 20 to midfoot region 18 along medial side 22 of midsole 10, and to forefoot region 16 along lateral side 24. It is to be appreciated that second portion 14 can be positioned at any desired location along midsole 10.

A mold assembly 26 used to form midsole 10 is seen in FIGS. 2-5, and includes a first portion 28 and a second portion 30. In the illustrated embodiment, first portion 28, which is positioned beneath second portion 30, forms a bottom surface and a portion of the medial and lateral sides of midsole 10, while second portion 30 forms a top surface and a complimentary portion of the medial and lateral sides of midsole 10. It is to be appreciated that in other embodiments, first and second portions 28, 30 can have a different positional relationship with respect to one another.

First portion 28 includes a substantially foot-shaped first recess 32 formed therein, and second portion 30 includes a substantially foot-shaped second recess 34 formed therein. First recess 32 and second recess 34 combine to form a midsole recess 36 when mold assembly 26 is closed, as seen in FIG. 5.

First portion 28 includes a first lower overflow recess 38 and a first lower channel 40 connecting the first lower overflow recess 38 to the first recess 32. Second portion 30

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includes a first upper overflow recess 42 and a first upper channel 44 connecting first upper overflow recess 42 to second recess 34.

When mold assembly 26 is closed, as seen in FIG. 5, the first lower and upper channels 40, 44 combine to define a first channel 46. First lower overflow recess 38 and first upper overflow recess 42 combine to define a first overflow chamber 48, with first channel 46 connecting first overflow chamber 48 to midsole recess 36.

In the illustrated embodiment of FIGS. 3-5, first channel 46 and first overflow chamber 48 extend around heel region 20 of first recess 32, along medial side 22 to midfoot region 18, and along lateral side 24 to forefoot region 16. This can be best seen in FIG. 3, which shows first lower channel 40, which forms part of first channel 46, and first lower overflow recess 38, which forms part of first overflow chamber 48. It is to be appreciated that first channel 46 could extend only around heel region 20, or extend to any desired point along first recess 32.

As seen in FIG. 5, first channel 46 has a height A that is less than a height B of first overflow chamber 48. In a preferred embodiment, height A of first channel 46 is approximately 1 mm. In a preferred embodiment, height B of first overflow chamber 48 is approximately 5 mm.

Additionally, in certain preferred embodiments, first channel 46 and first overflow chamber extend outwardly from first recess 32 approximately 5 mm.

As seen in the embodiment illustrated in FIG. 5, the cross-section of first channel 46 is substantially rectangular, while the cross-section of first overflow chamber 48 is substantially circular. It is to be appreciated that both first channel 46 and first overflow chamber 48 can have any desired shape, and that first overflow chamber 48 need not necessarily be larger than first channel 46. In other embodiments, first overflow chamber 48 could be connected directly to first recess 32 without a need for first channel 46 to connect first overflow chamber 48 to first recess 32.

To form midsole 10 in mold assembly 26, a first preform 50 and a second preform 52 are seated or placed in first recess 32 of first portion 28. In certain embodiments, first and second preforms 50, 52 are formed of EVA. In the illustrated embodiment, second preform 52 is seated beneath first preform 50. Second preform extends from a rear edge of heel portion 20 to midfoot region 18 on medial side 22 and to forefoot region 16 on lateral side 24.

A release agent may be applied to the exposed surface of first and second preforms 50, 52 and/or the surfaces of first recess 32 and second recess 34 in order to facilitate the separation of midsole 10 from mold assembly 26 after its formation. The release agent may be a spray release agent or any other suitable release agent. Suitable materials for the release agent include, for example, siloxane and water. Other suitable release agents will become readily apparent to those skilled in the art, given the benefit of this disclosure.

Mold assembly 26 is then closed, as seen in FIG. 5, so that first portion 28 of mold assembly 26 is in contact with second portion 30 of mold assembly 26, with first and second preforms 50, 52 seated within midsole recess 36. First portion 28 and second portion 30 may be hinged together, or they may be separate elements that are suitably aligned and placed in contact with one another.

Mold assembly 26 with first preform 50 and second preform 52 contained therein is then heated to a predetermined temperature for a predetermined period of time. In certain embodiments, mold assembly 26 at this point is heated to a temperature of between about 125° C. and about

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135° C. In more preferred embodiments, mold assembly 26 is heated to a temperature of about 130° C.

In certain embodiments, mold assembly is heated for between about 5 and about 8 minutes, thereby causing first and second preforms 50, 52 to partially melt and bond together to form midsole 10, with a portion of first and second preforms 50, 52 flowing through first channel 46 into first overflow chamber 48 to form a first overflow portion 54.

After this heating step is complete, mold assembly 26 is opened, and midsole 10, formed of first portion 12 and second portion 14 with first overflow portion 54 extending outwardly from an exterior surface of midsole 10, is removed from mold assembly 26. As seen in FIG. 6, when midsole 10 is removed from mold assembly 10, it expands to some degree. In certain embodiments, midsole 10 may expand to approximately 163% of its original size.

After midsole 10 has expanded and stabilized, first overflow portion 54 is then cut away from the periphery of midsole 10, as shown in FIG. 7.

Providing first overflow chamber 48 and first channel 46 reduces the negative aesthetic effects of bleeding that can result from bonding first and second preforms 50, 52 together. As seen in FIG. 1 and FIG. 7, after cutting away first overflow portion 54, there is a more distinct line defining the boundary between first portion 12 and second portion 14.

Although, as noted above, first preform 50 and second preform 52 may both be formed of EVA, they may have different colors, as well as different physical properties such as resiliency, stiffness, and other parameters. Providing different colors and physical properties for first and second preforms 50, 52 and, therefore, first and second portions 12, 14, allows midsole 10 to be customized or optimized to provide particular aesthetic and/or performance characteristics.

For example, in certain embodiments, first portion 12 has a hardness of approximately 48 Asker C, while second portion 14 has a hardness of approximately 54 Asker C.

Another embodiment of a midsole 10' is shown in FIG. 8, in which second portion 14' is positioned only in heel region 20 of midsole 10' beneath first portion 12', and a third portion 56 is positioned in forefoot region 16 of midsole 10' beneath first portion 12'. Midsole 10' is formed in substantially the same manner as midsole 10.

As seen in FIG. 10, which illustrates a section view of a forefoot region 16 of mold assembly 26' used to form midsole 10', a third preform 58, which forms third portion 56, is positioned beneath first preform 50' in mold assembly 26'.

In mold assembly 26', seen in FIGS. 9-11, first channel 46 and first overflow chamber 48 extend only around heel region 20 of midsole recess 36, as best seen in FIG. 9 where first lower channel 40' and first lower overflow recess 38' are shown. Mold assembly 26' also includes a second channel 60 and a second overflow chamber 62 in a forefoot region 16 on lateral side 24, as seen in FIG. 11, which is formed by a second lower channel 64 and a second lower overflow recess 66 in first portion 28' in combination with a second upper channel 68 and a second upper overflow recess 70 in second portion 14', which are shown in FIG. 10. Second channel 60 and second overflow chamber 62 cooperate to produce a second overflow portion 72 on midsole 10', which is cut away as described above.

Further, as seen in FIG. 11, mold assembly 26' includes a third channel 74 and a third overflow chamber 76 in a forefoot region 16 on medial side 24, which is formed by a third lower channel 78 and a third lower overflow recess 80

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in first portion **12'** in combination with a third upper channel **82** and a third upper overflow recess **84** in second portion **14'**, which are shown in FIG. **10**. Third channel **74** and third overflow chamber **76** cooperate to produce a third overflow portion **86** on midsole **10'**, which is cut away as described above.

It is to be appreciated that the channels and corresponding overflow chambers can be positioned at any point along the recess in the mold assembly. For example, a single mating channel and overflow chamber could extend around the entire periphery of the recess in the mold assembly, or extend only around forefoot region **16**, only in heel region **20**, or at any other single desired location. In other embodiments, any number of channel/overflow chamber combinations can be positioned at any desired locations along the recess in the mold assembly.

Another embodiment is shown in FIG. **12**, in which the entirety of first portion **12** is positioned above second portion **14**. It is to be appreciated that the shape and configuration of a color separation line **88** between first portion **12** and second portion **14** can affect the quality of the line. A smooth and continuous line **88** about the entire perimeter of midsole **10** can help to provide a high quality color separation line. Variations of the configuration of separation line **88** can potentially lead to bleeding. If separation line **88** varies upwardly or downwardly sharply, such as at the very tip of forefoot portion **16**, for example, it can lead to bleeding. It is to be appreciated that the thickness of first portion **12** and second portion **14** affects the quality of midsole **10** as well. In certain embodiments, the thickness of first portion **12** and second portion **14** is at least approximately 7 mm. In other embodiments, the forefoot portion **16** of first portion **12**, beyond approximately 70% of the length of midsole **10** measured from the rearmost edge of heel portion **20**, can be as thin as approximately 4 mm.

In certain embodiments, as illustrated in FIG. **13**, separation line **88** may extend forwardly from heel portion **20** and then angle upwardly to the upper surface of midsole **10**, such that first portion **12** extends only in heel portion **20**. In certain embodiments, the angle of separation line **88** as it angles upwardly is approximately 45°. Angles significantly steeper or shallower than this can create manufacturing and quality issues.

In certain embodiments, as illustrated in FIG. **14**, first portion **28** of mold assembly **26** has a projection **90** that extends inwardly into first recess **32** about its upper and inner peripheral edge. Projection **90** forms a corresponding recess **92** in second preform **52** and ultimately second portion **14** of midsole **10**. Recess **92** is positioned just below separation line **88** in midsole **10**.

In certain embodiments, as seen in FIG. **15**, the maximum width **W** of the upper surface of recess **92**, which is the exposed lower surface of first portion **12**, is approximately 1 mm. In certain embodiments, the maximum height **H** of recess **92** is approximately 2.5 mm.

In certain embodiments, as seen in FIG. **16**, the maximum draft **D**, that is the taper of the exterior surface of molded midsole **10**, is approximately 7 mm, as measured from bite line **94** of first portion **14** (where midsole **10** meets the upper) to the outermost edge of midsole **10**, seen here as the rearmost edge of heel portion **20**.

It is to be appreciated that mold assembly **26** should not have any undercuts. Undercuts in second portion **30** of mold assembly **26** would hit and interfere with first midform **50** when mold assembly **26** is closed.

Thus, while there have been shown, described, and pointed out fundamental novel features of various embodi-

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ments, it will be understood that various omissions, substitutions, and changes in the form and details of the devices illustrated, and in their operation, may be made by those skilled in the art without departing from the spirit and scope of the invention. For example, it is expressly intended that all combinations of those elements and/or steps which perform substantially the same function, in substantially the same way, to achieve the same results are within the scope of the invention. Substitutions of elements from one described embodiment to another are also fully intended and contemplated. It is the intention, therefore, to be limited only as indicated by the scope of the claims appended hereto.

What is claimed is:

1. A method of manufacturing a midsole for an article of footwear, method comprising:

placing a first perform over and into contact with a second perform within a midsole recess of a mold, the midsole recess defined by a first recess in a first portion of the mold and a second recess in a second portion of the mold, a surface of the first portion and a surface of the second portion cooperating to define a first overflow chamber and a first channel connecting the first overflow chamber to the midsole recess, the first portion having a projection extending inwardly into the first recess about an upper peripheral edge thereof, and an uppermost surface of the projection defining a lowermost surface of the first channel;

closing the mold by positioning the first and second portions in contact with one another;

heating the mold for a predetermined period of time at a predetermined temperature after the mold is closed such that the first and second preforms melt and bond together to form within the midsole recess a midsole having a separation line between material of the first and second preforms, with a portion of each of the first and second preforms flowing over the projection through the first channel and into the first overflow chamber to form a first overflow portion, and with the projection forming the second perform a projection recess positioned just below the separation line;

removing the midsole from the mold, whereby the midsole expands to a completely expanded state after said removing; and

cutting away the first overflow portion of the midsole after the midsole has expanded to the completely expanded state so as to leave material of the first perform overhanging and forming an uppermost surface over the projection recess at the separation line.

2. The method of claim 1, wherein the predetermined period of time is between about 5 minutes and about 8 minutes, and the predetermined temperature is about 130° C.

3. The method of claim 1, wherein the first and second preforms are formed of EVA.

4. The method of claim 1, wherein a color of the first preform is different than a color of the second preform.

5. The method of claim 4, wherein the separation line is a smooth and continuous color separation line between the different colors of the first and second preforms and extends about the entire perimeter of the midsole.

6. The method of claim 1, wherein a physical property of the first preform is different than a physical property of the second preform.

7. The method of claim 1, wherein a maximum width of the first perform material hanging over the projection recess is approximately 1 mm.

8. The method of claim 1, wherein a maximum height of the projection recess extending to the overhanging first preform material is approximately 2.5 mm.

9. The method of claim 1, wherein the projection recess and overhanging first preform material thereover extend about the entire perimeter of the midsole.

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